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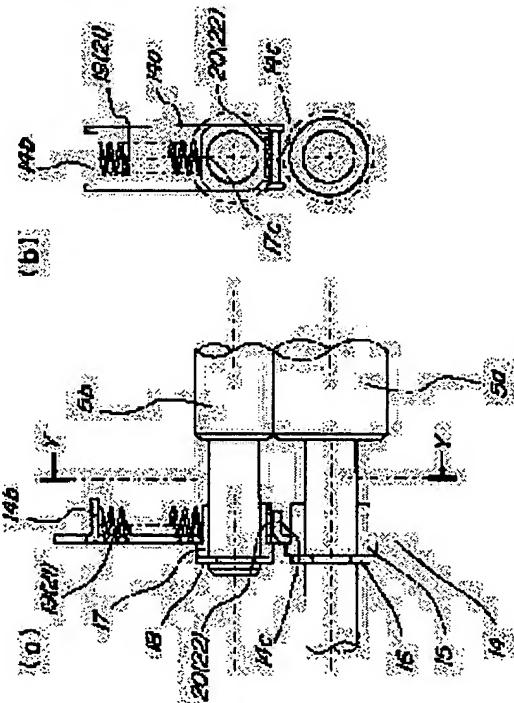
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## (54) SHEET CARRYING DEVICE AND IMAGE FORMING DEVICE AND IMAGE READER

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a sheet carrying device, an image forming device and an image reader having this sheet carrying device capable of highly accurately carrying a sheet by preventing the occurrence of a carrying error when the sheet rushes in and separates from a nip part of a carrier roller and a pinch roller when sandwiching and carrying the sheet by the carrier roller and the pinch roller.



**SOLUTION:** In this sheet carrying device for sandwiching and carrying the sheet by the carrier roller 5a and the pinch roller 5b for pressing the sheet to the carrier roller, the sheet carrying device is characterized by having a compression spring 19 for energizing the pinch roller in the direction for strengthening sheet pressing force by the carrier roller 5a and the pinch roller 5b, and a plate spring 20 for energizing the pinch roller in the direction for weakening the sheet pressing force by the carrier roller 5a and the pinch roller 5b.

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## CLAIMS

## [Claim(s)]

[Claim 1] The sheet transport device characterized by to have a 2nd energization means energize a sheet in the sheet transport device which carries out pinching conveyance in the direction where the sheet thrust by 1st energization means to energize in the direction where the sheet thrust by said drive body of revolution and press member becomes strong, and said drive body of revolution and press member becomes weak by drive body of revolution and the press member which presses a sheet to this.

[Claim 2] It is the sheet transport device according to claim 1 characterized by constituting said press member possible [ displacement ] to said drive body of revolution, for said 1st energization means energizing said press member in said direction of drive body of revolution, and said 2nd energization means energizing said press member in the direction which separates from said drive body of revolution.

[Claim 3] The sheet transport device according to claim 1 or 2 characterized by having constituted said 1st energization means and the 2nd energization means from a spring member, and setting up the load rate of said 2nd energization means greatly rather than the load rate of said 1st energization means.

[Claim 4] The sheet transport device according to claim 3 characterized by having constituted said 1st energization means from a compression spring, and constituting said 2nd energization means from a flat spring.

[Claim 5] The sheet transport device characterized by having the 1st conveyance means and the 2nd conveyance means which were constituted from a sheet transport device of a publication in any 1 term of claim 1 thru/or claim 4, respectively, and setting up more greatly than the sheet pinching force by said 2nd conveyance means which is in the sheet conveyance direction downstream rather than this 1st conveyance means the sheet pinching force by said 1st conveyance means.

[Claim 6] Said press member is a sheet transport device given in any 1 term of claim 1 characterized by being the follower body of revolution which carries out follower rotation at said drive body of revolution thru/or claim 5.

[Claim 7] The sheet transport device according to claim 1 to 6 to which the energization force of said 2nd energization means becomes small as spacing between said drive body of revolution and said press members becomes large.

[Claim 8] It is the sheet transport device according to claim 7 constituted so that the energization force of said 2nd energization means may not act when spacing between said drive body of revolution and said press members becomes larger than a predetermined value.

[Claim 9] In the sheet transport device which pinches and conveys a sheet by drive body of revolution and follower body of revolution It has an energization means to generate the sheet thrust by said drive body of revolution and said follower body of revolution. Said energization means is a sheet transport device characterized by having the 1st load rate when spacing of said drive body of revolution and said follower body of revolution is the 1st predetermined value, and having the 2nd load rate at the time of the 2nd predetermined value smaller than said 1st predetermined value.

[Claim 10] Said 1st load rate is a sheet transport device characterized by being smaller than said 2nd load rate.

[Claim 11] It has a 1st conveyance means to convey a sheet, and the 2nd conveyance means of the downstream of the conveyance direction by said 1st conveyance means. Said 2nd conveyance means pinches and conveys a sheet by drive body of revolution and follower body of revolution. It has an energization means to generate the sheet thrust by said drive body of revolution and said follower body of revolution. When said 2nd conveyance means pinches the sheet of the 1st thickness, said energization means has the 1st load rate. When the sheet of the 2nd thickness thinner than said 1st thickness is pinched, it has the 2nd load rate. The tip of the sheet of the 1st thickness conveyed by said 1st conveyance means In case it advances into the nip of said drive body of revolution and said follower body of revolution, the conveyance direction component of the force in which a sheet tip originates in the energization force of said energization means received from said drive body of revolution and said follower body of revolution It is the sheet transport device characterized by said 1st load rate being smaller than said 2nd load rate so that it may not become

larger than the conveyance force by said 1st conveyance means.

[Claim 12] The load rate of said energization means is a sheet transport device according to claim 11 which becomes the 1st load rate when said 2nd conveyance means conveys the sheet more than predetermined thickness.

[Claim 13] The 1st conveyance means which has an energization means to pinch and convey a sheet by the 1st drive body of revolution and the 1st follower body of revolution, and to generate the sheet thrust by said drive body of revolution and said follower body of revolution, It is arranged at the downstream of the conveyance direction by said 1st conveyance means, and has a 2nd conveyance means to pinch and convey a sheet by the 2nd drive body of revolution and the 2nd follower body of revolution. It has a regulation means to regulate one [ at least ] rotation among the 2nd drive body of revolution of said 2nd conveyance means, and the 2nd follower body of revolution. When said 1st conveyance means pinches the sheet of the 1st thickness, said energization means has the 1st load rate. When the sheet of the 2nd thickness thinner than said 1st thickness is pinched, it has the 2nd load rate. In case the back end of the sheet of said 1st thickness escapes from said 1st drive body of revolution and 1st follower body of revolution The conveyance direction component of the force in which the sheet back end originates in the energization force of said energization means received from said 1st drive body of revolution and said 1st follower body of revolution It is the sheet transport device characterized by said 1st load rate being smaller than said 2nd load rate so that it may not become larger than the force which prevents advance of the sheet resulting from the resistance torque in the bearing of said 2nd drive body of revolution and said 2nd follower body of revolution, and the load torque by said regulation means.

[Claim 14] The load rate of said energization means is a sheet transport device according to claim 13 which becomes the 1st load rate when said 1st conveyance means conveys the sheet more than predetermined thickness.

[Claim 15] Image formation equipment characterized by having a sheet transport device given in claim 1 for conveying a sheet thru/or any 1 term of claim 14, and an image recording means to record an image at a sheet in the image formation equipment which carries out image formation to the sheet conveyed.

[Claim 16] Said sheet transport device is image formation equipment according to claim 15 characterized by being prepared in the upstream and the downstream of said image recording means in the sheet conveyance direction.

[Claim 17] Said account image recording means is image formation equipment according to claim 16 characterized by breathing out and recording ink according to a signal.

[Claim 18] Said image recording means is image formation equipment according to claim 17 characterized by carrying out the regurgitation of the ink using the heat energy which energizes on an electric thermal-conversion object according to a signal, and this electric thermal-conversion object emits.

[Claim 19] The image reader characterized by having a sheet transport device given in claim 1 for conveying a sheet thru/or any 1 term of claim 14, and an image reading means to read the image of a sheet in the image reader which reads the image indicated by the sheet conveyed.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to image readers, such as a scanner, at image formation equipment lists, such as a printer equipped with the sheet transport device and this which can convey a sheet with high degree of accuracy in more detail about an image reader in the image formation equipment list equipped with the sheet transport device and this which pinch and convey a sheet, a copying machine, and facsimile.

[0002]

[Description of the Prior Art] If variety development is carried out and equipments, such as a scanner which reads the image indicated by the printer which forms an image to convey a sheet today, the copying machine, or the sheet, are in such equipment, it has the sheet transport device which generally carries out pinching conveyance of the sheet by the roller pair.

[0003] Here, the conventional sheet conveyance configuration is explained with reference to drawing 9 thru/or drawing 11. Drawing 9 is the outline configuration explanatory view around the Records Department of the conventional recording device which adopted the ink jet recording method which breathes out and records ink from a recording head 51.

[0004] In drawing 9, the recording head 51 which has ink discharge part 51a has countered with the platen 52, and the conveyance roller 53 and pinch roller 54 as 1st conveyance means are arranged at the sheet conveyance direction upstream (only henceforth the "upstream") of this platen 52. This pinch roller 54 is a spring 55P1 to the direction of the conveyance roller 53. It is energized by the force.

[0005] Moreover, the conveyance roller 56 and pinch roller 57 as 2nd conveyance means are arranged at the sheet conveyance direction downstream (only henceforth the "downstream") of a platen 52, and a pinch roller 57 is a spring 58P2 to the direction of the conveyance roller 56. It is energized by the force.

[0006] By the printer of a serial scanning method using the above-mentioned ink jet method etc., the step feed of the sheet 59 as a recorded material is carried out to a predetermined width-of-face [ every ] intermittent target, and the image is recorded predetermined width of face every.

[0007] In addition, in order to make small the margin produced on a sheet 59, where a sheet is pinched only with the 1st conveyance means, it records on the point of a sheet 59, where a sheet 59 is pinched with the 1st conveyance means and the 2nd conveyance means, it records on the pars intermedia of a sheet 59, and where a sheet 59 is pinched only with the 2nd conveyance means, it is recording on the back end section of a sheet 59.

[0008] Where a sheet 59 is pinched with either the 1st conveyance means or the 2nd conveyance means, even when record is performed, in order for a sheet 59 to shift and not to degrade record grace, it is necessary to pinch a sheet 59 firmly. For this reason, force P1 energized by the pinch roller 54 with a spring 55 And force P2 energized by the pinch roller 57 with a spring 58 It is set as the value large enough.

[0009] Drawing 10 is the important section strabism explanatory view of the recording device explained in drawing 9. The gear 61 and the gear 62 are attached in the axis end section of the conveyance roller 53 and the conveyance roller 56, respectively. The idler gear 63 is formed between this gear 61 and a gear 62, and the drive transfer system is formed. Furthermore, on the gear 62, minor diameter gear 64a of the two-step gear 64 has geared, and the gear 65 attached in the output shaft of a motor 66 meshes to major-diameter gear 64b of the two-step gear 64. Thus, the conveyance roller 53 and the conveyance roller 56 drive by the motor 66.

[0010] Moreover, if it is in the recording device which treats only a thick sheet restrictively As the technique indicated in the utility model registration No. 1599199 official report is used and it is shown in drawing 11 It is also possible to prepare the concave section in the peripheral surface of a roller 71 along with the circumferencial direction, to form the

cross-section rectangle-like gap section larger than the width of face of a sheet with spacing narrower than the thickness of a sheet between a roller 71 and a roller 72, and to take the configuration which conveys a sheet.

[0011]

[Problem(s) to be Solved by the Invention] However, a technical problem which is explained below occurs with the above sheet conveyance configurations. That is, this is a remarkable phenomenon when a sheet 59 is thick, but in case the point of a sheet 59 rushes into the nip section of the conveyance roller 56 as 2nd conveyance means, and a pinch roller 57, conveyance precision tends to fall by receiving the drag force of the conveyance direction and the opposite sense from both the roller front face. In case similarly the back end section of a sheet 59 secedes from the nip section of the conveyance roller 53 as 1st conveyance means, and a pinch roller 54 although it is a remarkable phenomenon when a sheet 59 is thick, it becomes easy for conveyance precision to fall by the conveyance direction's beginning to kick from both the roller front face, and receiving the force.

[0012] These phenomena are explained in detail using drawing 12 thru/or drawing 15. The backlash in the interlocking part of the gear train which constitutes a drive transfer system is one of causes of inrush of a sheet, and the conveyance error at the time of balking. It clarifies about the relation between a conveyance error and backlash first.

[0013] (Backlash and conveyance error) As an example out of the gear train which constitutes a drive transfer system, drawing 12 and drawing 13 are the \*\* type explanatory views having shown the condition of interlocking of minor diameter gear 64a of a gear 62 and the two-step gear 64. In drawing 12, the driving force of the direction of an arrow head e is applied to minor diameter gear 64a of the two-step gear 64, as shown in the enlarged drawing of drawing 12 (b), 64a contacts in the part of A and, as for the minor diameter gear of a gear 62 and the stage gear 64, the clearance exists in the part of I. This is the backlash of interlocking of a gear.

[0014] In case a sheet 59 rushes into the nip section of the conveyance roller 56 as 2nd conveyance means, and a pinch roller 57, a sheet 59 receives the force in the direction of the arrow head f of drawing 12 (a). Consequently, although the force is transmitted also to a gear 62 through a drive gear train, in order to receive the force in the direction G without the clearance between gears, minor diameter gear 64a of the two-step gear 64 holds its ground in the location.

[0015] On the other hand, it is the reverse when a sheet 59 secedes from the nip section of the conveyance roller 53 as 1st conveyance means, and a pinch roller 54. The condition is shown in drawing 13.

[0016] As shown in drawing 13 (a), in case a sheet 59 secedes from the nip section of the conveyance roller 53 as 1st conveyance means, and a pinch roller 54, the foot press force is received in the direction of an arrow head h. Consequently, the force is transmitted also to a gear 62 through a drive gear train, and the force to the direction of arrow-head i is received. Since the direction of this force is a direction where the clearance between gears exists as shown in drawing 13 (b), a gear 62 will rotate easily and a conveyance error will produce it. It is common to try for the conveyance roller 56 not to rotate easily by the actual printer by giving the load torque of remarkable magnitude to the conveyance roller 56 with a brake means, even if it receives said foot press force. However, it is more efficient to adopt the approach of making load torque small as much as possible, and making the foot press force small, since many energy will be used to rotate the conveyance roller 56 so much if load torque is enlarged.

[0017] Here, although only the relation of minor diameter gear 64a of a gear 62 and the two-step gear 64 was described, the same thing can be said also about other gears. That is, in the interlocking section of each gears, in case a sheet 59 rushes into the nip section of the conveyance roller 56 as 2nd conveyance means, and a pinch roller 57, the force is received in the direction without backlash, and in case a sheet 59 secedes from the nip section of the conveyance roller 53 as 1st conveyance means, and a pinch roller 54, the relation of receiving the force in the direction in which backlash occurs does not change.

[0018] Next, when a sheet tip rushes into the 2nd conveyance means, and in case the sheet back end secedes from the 1st conveyance means, the force which a sheet receives is explained.

[0019] Further, from the conveyance roller 56 and pinch roller 57 as 2nd conveyance means, since the conveyance roller 53 as 1st conveyance means and a pinch roller 54, and the force that a sheet 59 receives are expressed with a vector, drawing 14 thru/or drawing 15 deform dimension relation to some extent, and draws it.

[0020] (Force received when a sheet tip rushes into a roller pair) The point of a sheet 59 expresses the condition of rushing into the nip section of the conveyance roller 56 as 2nd conveyance means, and a pinch roller 57, and drawing 14 expresses the moment the conveyance roller 56 and a pinch roller 57 just separate.

[0021] the contact pressure of the pinch roller 54 by the side of the 1st conveyance means -- the contact pressure of the pinch roller 57 by the side of the P1 and 2nd conveyance means -- P2 it is -- a case -- a sheet 59 -- the conveyance roller 53 and a pinch roller 54 -- the force of the following magnitude is further received from the conveyance roller 56 and a pinch roller 57.

[0022] It is [0023] a 1st conveyance means side.

Conveyance roller 53 :  $Na1 = P1 \dots (1)$  [0024]

Pinch-roller 54:  $Nb1 = P1 \dots (2)$  [0025] It is [0026] a 2nd conveyance means side.

Conveyance roller 56 :  $Na2 = P2 / \cos\thetaaa2 \dots (3)$  [0027]

Pinch-roller 57:  $Nb2 = P2 / \cos\thetaab2 \dots (4)$  [0028] As shown in drawing 14, the direction of the vector of each force is the direction of a normal of the circle in the contact parts of a sheet 59 and each roller. Furthermore, between a sheet 59 and each roller, frictional force exists as potential, and the coefficient of friction is expressed with the following notations.

[0029] Between a sheet 59 and the conveyance rollers 53 :  $\mu_{a1}$  [0030] Between a sheet 59 and pinch rollers 54:  $\mu_{b1}$

[0031] Between a sheet 59 and the conveyance rollers 56 :  $\mu_{a2}$  [0032] Between a sheet 59 and pinch rollers 57:  $\mu_{b2}$

[0033] As for the conveyance roller 53 and the conveyance roller 56, a diameter is equal, and since the rotational frequency is also set up equally, only the same distance tends to convey a sheet 59 on a roller front face. When the conveyance roller 53 tends to do distance  $s$  conveyance of a sheet 59, the conveyance roller 56 also tends to do distance  $s$  conveyance of a sheet 59, but supposing a slip does not arise in a point of contact J, only  $x$  [horizontally smaller than  $s$ ] will not be conveyed, but the conveyance difference  $d$  will produce a sheet 59 in the conveyance roller 53 and conveyance roller 56 side.

[0034]  $d = s - x \dots (5)$  [0035] The range which this conveyance difference  $d$  produces is range until the tip of a sheet 59 comes to the top-most vertices of the conveyance roller 56 from the condition of drawing 14 that a sheet 59 begins to contact the conveyance roller 56. Therefore, the conveyance difference  $d$  is [0036].

$d = ra \sin\thetaaa2 - ra \sin\thetaab2 \dots (6)$  [0037] It can express. However,  $ra$  It is the radius of the conveyance roller 56 and is  $\thetaaa2$ . As shown in drawing 14, it is the include angle  $\thetaaa2$  in case a sheet 59 and the conveyance roller 56 begin to contact (deg). However, all the values this  $d$  do not serve as a conveyance error.

[0038] When the sheet 59 is made of the thick ingredient with the strong waist, this can be considered as the rigid body. In this case, a slip arises with either the conveyance roller 53 or the conveyance roller 56. When a slip arises in the conveyance roller 53 side, it serves as a conveyance error and record precision deteriorates. The size relation of the conveyance direction component of the force which can work on a sheet 59 determines this condition, and the conditions which a conveyance error generates become like the following formula.

[0039]

$(\mu_{a1} + \mu_{b1}) xP1 < \mu_{a2} x(P2 / \cos\thetaaa2) x\cos\thetaaa2 + \mu_{b2} x(P2 / \cos\thetaab2) x\cos\thetaab2 + (P2 / \cos\thetaaa2) x\sin\thetaaa2 + (P2 / \cos\thetaab2) x\sin\thetaab2 \dots (7)$  [0040] Since it is  $\sin\thetaaa2 / \cos\thetaaa2 = \tan\thetaaa2$ , a formula (7) can be rewritten as follows.

[0041]

$(\mu_{a1} + \mu_{b1}) xP1 < \mu_{a2} x(P2 / \cos\thetaaa2) x\cos\thetaaa2 + \mu_{b2} x(P2 / \cos\thetaab2) x\cos\thetaab2 + P2 x\tan\thetaaa2 + P2 x\tan\thetaab2 \dots (8)$  [0042] It is  $\mu_{b1}$  here. And  $\mu_{b2}$  As mentioned above, it is coefficient of friction between a sheet 59 and a pinch roller 54 and between a sheet 59 and a pinch roller 57, and it is  $\mu_{b1} xP1$ . And  $\mu_{b2} x(P2 / \cos\thetaab2)$  expresses the magnitude of the conveyance direction component of the force which can act on a sheet 59 by friction from a pinch roller 54 and a pinch roller 57, respectively.

[0043]  $\mu_{b1} xP1 \dots (9)$  [0044]  $\mu_{b2} x(P2 / \cos\thetaab2) \dots (10)$  [0045] A drive is not applied to a pinch roller 54 and a pinch roller 57, but it is supported so that it can rotate freely. the load torque by the sliding friction of bearing of a pinch roller 54 and a pinch roller 57 -- respectively --  $T1$  And  $T2$  \*\* -- if it carries out -- these -- radius  $rb1$  of each pinch roller And  $rb2$  The value which \*\*(ed)  $(T1 / rb1)$  and --  $(T2 / rb2)$  Load torque  $T1$  which appears in the front face of each pinch roller And it is the magnitude of the force corresponding to  $T2$ .

[0046]  $(T1 / rb1) \dots (11)$  [0047]  $(T2 / rb2) \dots (12)$  [0048] Usually, it is the load torque  $T1$  from said frictional force, a formula (9), and a formula (10). And  $T2$  Since a pinch roller surface reduced property, a formula (11), and the formula (12) are smaller, these can be adopted, and a formula (8) can be rewritten as follows.

[0049]

$\mu_{a1} xP1 + (T1 / rb1) < \mu_{a2} xP2 + (T2 / rb2) x\cos\thetaab2 + P2 x\tan\thetaab2 \dots (13)$  [0050] Here, the following concrete values are applied and the formation range of a formula (13) is verified.

[0051]  $\mu_{a1} = \mu_{a2} = 0.65$ ,  $P1 = P2 = 2.9421N$  (300gf),  $T1 = T2 = 0.58836mJ$  (60 gf-mm),  $2 = 1.5mm$  [0052] of  $rb1 = rb$  (s) Moreover, it is each radius of the conveyance roller 53 and the conveyance roller 56  $ra1$  And suppose that  $ra2$  and thickness  $t$  of a sheet 59 are the following values.

[0053]  $2 = 2.156mm$  of  $ra1 = ra(s)$ ,  $t = 0.3mm$  [0054] Include angle  $\thetaaa2$  in case a sheet 59 begins to contact the conveyance roller 56 and a pinch roller 57  $\thetaab2$  It can be found geometrically and becomes the following values.

[0055]  $\thetaaa2 = 28.30deg$ ,  $\thetaab2 = 19.26deg$  [0056] It will become the following values if these are substituted for the left part of a formula (13).

[0057]

$mua1 \times P1 + (T1 / rb1) = 2.30465N$  (235gf) .... (14) [0058] On the other hand, the value of the right-hand side of a formula (13) is as follows.

[0059]

$2 = 4.89369Ns$  (499gf) of  $mua2 \times P2 + (T2 / rb2) \times \cos\theta_{tab2} + P2 \times \tan\theta_{aa2} + P2 \times \tan\theta_{tab}$  .... (15) [0060] Since it becomes a formula (14) < type (15), the inequality of a formula (13) is realized. Therefore, it turns out that a sheet 59 produces a slip in the conveyance roller 53 side, a conveyance error occurs, and record precision deteriorates.

[0061] Then, the conveyance difference  $d$  is searched for. When the conditions of the 1st conveyance means and the 2nd conveyance means are similarly set up, it is an include angle  $\theta_{aa2}$  that the left part and the right-hand side of a formula (13) become equal. Include angle  $\theta_{tab2}$  Both magnitude is just going to serve as 0deg. The range which the conveyance difference  $d$  produces is range until the tip of a sheet 59 comes to the top-most vertices of the conveyance roller 56 from the condition of drawing 12 that a sheet 59 begins to contact the conveyance roller 56. Therefore, the value of the conveyance difference  $d$  is as follows that what is necessary is just to calculate a formula (6).

[0062]

$2 = 0.0136mm$  of  $d = r_a \theta_{aa2} - r_a \sin\theta_{aa2}$  .... (16) [0063] That is, a sheet 59 is 13.6 micrometers from the amount of conveyances of normal. It will be conveyed few and record precision cannot be guaranteed. Not only the above example but when the conditions of the 1st conveyance means and the 2nd conveyance means were generally set up almost similarly, the conveyance difference  $d$  exceeding the limit permitted occurred, and there was a fault of it becoming impossible to guarantee record precision.

[0064] (Force received when the sheet back end secedes from a roller pair) The back end section of a sheet 59 expresses the condition of seceding from the nip section of the conveyance roller 53 as 1st conveyance means, and a pinch roller 54, and drawing 15 expresses the moment the conveyance roller 53 and a pinch roller 54 just touch.

[0065] A sheet 59 receives the force of the following magnitude in the conveyance roller 53 and pinch roller 54 pan from the conveyance roller 56 and a pinch roller 57.

[0066] It is [0067] a 1st conveyance means side.

Conveyance roller 53 :  $Na1 = P1 / \cos\theta_{aa1}$  .... (17) [0068]

Pinch roller 54 :  $Na2 = P1 / \cos\theta_{tab1}$  .... (18) [0069] It is [0070] a 2nd conveyance means side.

Conveyance roller 56 :  $Nb1 = P2$  .... (19) [0071]

Pinch roller 57 :  $Nb2 = P2$  .... (20) [0072] As shown in drawing 15, the direction of the vector of each force is the direction of a normal of the circle in the contact parts of a sheet 59 and each roller. The difference from the conveyance error at the time of inrush must just be going to consider the conveyance error by the backlash in the interlocking section of the gear train which constitutes a drive transfer system. In order to rotate the conveyance roller 56 in the range for backlash of backlash and for a pinch roller 57 to also carry out follower rotation further, the force equivalent to the sliding drag force of bearing of each roller is required. The value which converted total of the sliding drag force of the conveyance roller 56 and a pinch roller 57 on the front face of the conveyance roller 56 is set to  $R$ . When a sheet 59 is kicked at in the range of backlash, a slip is not usually produced between a sheet 59 and the conveyance roller 56. The size relation of the conveyance direction component of the force which can work on a sheet 59 determines the conditions by which a sheet 59 is kicked at within the limits of backlash, and the conditions which a conveyance error generates become like the following formula.

[0073]

$(P1 / \cos\theta_{aa1}) \times \sin\theta_{aa1} + (P1 / \cos\theta_{tab1}) \times \sin\theta_{tab1} > R$  .... (21) [0074] Since it is  $\sin\theta/\cos\theta = \tan\theta$ , a formula (21) can be rewritten as follows.

[0075]

$P1 \times \tan\theta_{aa1} + P1 \times \tan\theta_{tab1} > R$  .... (22) [0076] Here, the following concrete values are applied and the formation range of a formula (22) is verified.

[0077]  $P1 = P2 = 2.9421N$  (300gf),  $R = 1.47105 Ns$  (150gf),  $2 = 1.5mm$  [0078] of  $rb1 = rb(s)$  Moreover, it is each radius of the conveyance roller 53 and the conveyance roller 56 as well as the explanation in the case of the inrush mentioned above  $ra1$  And  $ra2$  and thickness [ of a sheet 59 ]  $t$  Suppose that it is the following value.

[0079]  $2 = 2.156mm$  of  $ra1 = ra(s)$ ,  $t = 0.3mm$  [0080] Include angle  $\theta_{aa1}$  in case a sheet 59 secedes from the conveyance roller 53 and a pinch roller 54  $\theta_{tab1}$  It can be found geometrically and becomes the following values.

[0081]  $\theta_{aa1} = 19.26deg$   $\theta_{tab1} = 28.30deg$  [0082] When these values are used, the value of the left part of a formula (22) is as follows.

[0083]

$1 = 2.60866Ns$  (266gf) of  $P1 \times \tan\theta_{aa1} + P1 \times \tan\theta_{tab1}$  .... (23) [0084] Therefore, since the inequality of a formula (22)

is realized, it turns out that it will be kicked at although a sheet 59 is limited range which is called within the limits of the total amount of backlash, sheet conveyance precision falls, and record precision deteriorates.

[0085] Then, the conveyance error  $e$  by the foot press in this case is searched for. It is an include angle  $\theta_{aa1}$  that the left part and the right-hand side of a formula (22) become equal. Include angle  $\theta_{ab1}$  The range which magnitude is just going to serve as  $11.446\text{deg}(s)$  and  $16.573\text{deg}(s)$ , respectively, and the conveyance error  $e$  produces is an include angle  $\theta_{aa1}$ . It is the range which changes to  $19.26\text{deg}(s)$  from  $11.446\text{deg}(s)$ . Therefore, the following formula calculates the conveyance error  $e$  and a value is as follows.

[0086]

$e=ra1 \times (\sin(19.26\text{deg}) - \sin(11.446\text{deg})) = 0.2833\text{mm}$  .... (24) [0087] That is, within the limits of the total amount of the backlash of a gear drive train, a sheet 59 is a maximum of 283.3 micrometers from the amount of conveyances of normal. It will be conveyed mostly and record precision falls.

[0088] Not only the above example but when the conditions of the 1st conveyance means and the 2nd conveyance means were generally set up almost similarly, the conveyance error e beyond the limit permitted occurred, and the technical problem that record precision will fall occurred.

[0089] The following technical problems occurred besides the problem of degradation of the record precision by generating of the conveyance error explained above.

[0090] First, when the contact pressure of a pinch roller was set up in accordance with the thick sheet which needs the comparatively big conveyance force, there was a possibility that the contact pressure of a pinch roller may become superfluous to a thin sheet, and Siwa and a tear might occur on a sheet. Moreover, since the contact pressure of a pinch roller was superfluous in order to convey a thin sheet, the drive load also became large and there was a fault of consuming power vainly.

[0091] Furthermore, the technique indicated in the utility model registration No. 1599199 official report mentioned above is used. Along with the circumferencial direction, the concave section is prepared in the peripheral surface of the roller 71 as shown in drawing 11. When the configuration which forms the cross-section rectangle-like gap section with spacing narrower than the thickness of a sheet between a roller 71 and a roller 72 more widely than the width of face of a sheet, and conveys a sheet was taken, the sheet which can be conveyed will be limited only to a thick thing and the thin sheet had the technical problem that it could not convey.

[0092] This invention is what solves the conventional technical problem mentioned above. The purpose When carrying out pinching conveyance of the sheet by drive body of revolution and the press member, prevent generating of the conveyance error at the time of breaking away in the case in which a sheet rushes into the nip section of said drive body of revolution and press member, and highly precise sheet conveyance is enabled. Moreover, even if it is a thin sheet, the image formation equipment list equipped with the sheet transport device and this which can press down and convey a drive load certainly again is provided with an image reader.

[0093]

[Means for Solving the Problem] The typical configuration concerning this invention for attaining the above-mentioned purpose In the sheet transport device which carries out pinching conveyance of the sheet by drive body of revolution and the press member which presses a sheet to this Sheet thrust by 1st energization means to energize in the direction where the sheet thrust by said drive body of revolution and press member becomes strong, and said drive body of revolution and press member is characterized by having a 2nd energization means to energize in the direction which becomes weak.

[0094]

[Embodiment of the Invention] Next, image formation equipment equipped with the sheet transport device concerning 1 operation gestalt of this invention is explained with reference to drawing 1 thru/or drawing 8. In addition, with this operation gestalt, an ink jet printer is illustrated as an example of image formation equipment. Drawing 1 is an approximate account Fig. which expresses with a conveyance roller the configuration of the 2nd energization means energized to the 1st energization means and opposite direction which energize a pinch roller. The important section strabism explanatory view and drawing 3 to which drawing 2 expresses the configuration of the 2nd energization means are a graph showing the relation of the comprehensive energization force by the spacing [ of a conveyance roller and a pinch roller ], 1st, and 2nd energization means in the 1st conveyance means. Drawing 4 is a graph showing the relation of the comprehensive energization force by the spacing [ of a conveyance roller and a pinch roller ], 1st, and 2nd energization means in the 2nd conveyance means. Moreover, drawing 5 is an include angle theta2. It is a graph showing the relation of drag force, and drawing 6 is an include angle theta1. The graph showing the relation of the foot press force, the cross-section explanatory view in which drawing 7 shows the outline configuration of an ink jet printer, and drawing 8 are the important section perspective views showing the configuration of the Records Department of an

ink jet printer.

[0095] The [whole printer configuration] The outline configuration of an ink jet printer is first explained with reference to drawing 7.

[0096] This printer A conveys the sheet contained by the feed cassette 1 by the sheet transport device B, and after it records a predetermined image in the image recording means 2, it discharges it.

[0097] If sheet loading plate 1a is energized upwards by the pressurization members 1b and 1c in the feed cassette 1 and Sheet S is loaded into this sheet loading plate 1a, it will be set after Sheet S has run against 1d of contact members by said energization. If insertion wearing of this feed cassette 1 is carried out at the body 3 of equipment, the pressure welding of the sheet S in a cassette will be carried out to the feed roller 4 by energization of pressurization member 1b.

[0098] And if the start command of the means which is not illustrated is executed, the motor which carries out the rotation drive of the feed roller 4 will turn on, and the feed roller 4 will begin rotation. As for the sheet S with which it was fed by this, the separation feed only of top one in the edge of obstruction 1e of the shape of a wall of the feed cassette 1 is carried out. In addition, although the sheet S used with this operation gestalt is with a width-of-face die-length thickness [ of 54mm / 0.3mm thickness of 86mm ] card size and an ink absorber is applied to the base of a PET film, it cannot be overemphasized that the sheet which carries out image formation can use paper, a sheet plastic, etc. besides this.

[0099] Although the sheet by which separation feed was carried out from said feed cassette 1 is conveyed by the sheet transport device B, the sheet transport device concerning this operation gestalt is constituted by the 1st conveyance means 5 formed in the upstream of the record means 2, and the 2nd conveyance means 6 formed in the downstream of the record means 2. The 1st conveyance means 5 and the 2nd conveyance means 6 consist of conveyance rollers 5a and 6a as drive body of revolution, and pinch rollers 5b and 6b as a press member which presses a sheet to this conveyance roller 5a, and carries out follower rotation, respectively.

[0100] Although pinch rollers 5b and 6b are energized by the predetermined force to said conveyance rollers 5a and 6a so that a sheet can be pinched, about the configuration, it mentions later.

[0101] A record means 2 to record an image on the sheet S conveyed by said sheet transport device B scans recording head 2a crosswise [ sheet ] (the sheet conveyance direction and direction which intersects perpendicularly), and uses the ink jet recording method of the serial mold which records by breathing out ink from a recording head. That is, this recording head 2a is equipped with an energy generation means to generate the drop formation energy made to act on the liquid in the energy operation section prepared in a detailed liquid delivery (orifice), passage, and a part of this passage, and this operation section.

[0102] Irradiate electromagnetic waves, such as the record approach using electric machine conversion objects, such as a piezo-electric element, as such an energy generation means, and laser, they are made to generate heat, and there is the record approach using an energy-generation means heat a liquid and make a liquid breathe out with electric thermal-conversion objects, such as a heater element which has the record approach using an energy generation means to make a drop breathe out in the operation by this generation of heat, or an exoergic resistor, etc.

[0103] Since the recording head used for the ink jet record approach to which the sheet regurgitation of the liquid is carried out with heat energy also in it can arrange the liquid delivery (OIRIFISU) for breathing out the drop for record and forming the drop for regurgitation to high density, it can record high resolution. The recording head which used the electric thermal-conversion object as an energy generation means also in it is easy also for miniaturization, and the advance of a technique and the improvement in dependability in the latest semi-conductor field can utilize the advantage of remarkable IC technique or a micro processing technique more than enough, and high-density-assembly-izing is easy for it, and it is advantageous from a manufacturing cost being cheap.

[0104] The above-mentioned recording head 2a is carried in carriage 2b, and this carriage 2b carries out both-way migration crosswise [ of a sheet ] along with guide rails 2c and 2d. The above-mentioned recording head 2a records toward a vertical lower part to the sheet supported by platen 2e arranged in the location which counters.

[0105] Head 2aC which recording head 2a of this operation gestalt had equipped two or more heads recordable full color as shown in drawing 8 , and equipped Cyanogen C, Magenta M, Yellow Y, and each color ink of Black Bk, 2aM, 2aY, and 2aBk are installed in the scanning direction of carriage 2b side by side. Each above-mentioned color recording head records ink by 5.4187mm width of face on discharge and Sheet S from 256 nozzles located in a line with one train in the pitch of 1200dpi. 2f of driving belts is connected with carriage 2b which carried each above-mentioned color head, and it is constituted so that a both-way drive may be carried out in the direction of arrow-head b by the pulse motor which is not illustrated.

[0106] [Sheet transport device] As mentioned above, the 1st conveyance means 5 and the 2nd conveyance means 6 are arranged respectively at the upstream and the downstream of the above-mentioned Records Department, and whenever

it ends record for one line by recording head 2a mentioned above, only a distance equal to the direction of arrow-head a of drawing 8 to a recording width (record length of the record material conveyance direction) conveys Sheet S intermittently. The diameter D1 of the above-mentioned conveyance roller 5a and the diameter D2 of conveyance roller 6a are constituted equally. The gear 7 and the gear 8 are attached in the edge of conveyance roller 5a and conveyance roller 6a, respectively. The idler gear 9 is formed between the gear 7 and the gear 8, and the drive transfer system is formed. Furthermore, on the gear 8, minor diameter gear 10a of the two-step gear 10 has geared, and the pinion gear 12 attached in the output shaft of a motor 11 meshes to major-diameter gear 10b of the two-step gear 10. Thus, conveyance roller 5a and conveyance roller 6a drive by the motor 11.

[0107] Furthermore, the load torque T5 is given to conveyance roller 6a with brake block 13. In addition, the magnitude of said load torque T5 is as follows.

[0108]  $T5=1.4709mJ$  (150 gf-mm) .... (25) [0109] {Energization means} The energization force of each said roller pair in here is explained. Drawing 1 expresses the configuration of a means to energize pinch roller 6b to conveyance roller 6a of a means to energize pinch roller 5b to conveyance roller 5a of the 1st conveyance means 5, or the 2nd conveyance means 6, (a) is a front view and (b) is the Y-Y cross-section explanatory view of (a).

[0110] The configuration which has taken the configuration which energizes pinch rollers 5b and 6b to the conveyance rollers 5a and 6a in this operation gestalt at each both ends of the 1st conveyance means 5 and the 2nd conveyance means 6, and is energized in the 1st conveyance means 5 and the 2nd conveyance means 6 is made the same.

[0111] (Energization force in the 1st conveyance means) The edge of the longitudinal direction one side of each roller is taken up, and drawing 1 explains the configuration for first energizing pinch roller 5b to conveyance roller 5a in the 1st conveyance means 5.

[0112] In drawing 1, 14 is a side plate which constitutes the case of an ink jet printer, 15 is a plain bearing, and fitting of it is carried out to the hole of a side plate 14, and it is being fixed to it. Conveyance roller 5a was supported to revolve enabling free rotation, E mold snap ring 16 was inserted in the edge of conveyance roller 5a, and the plain bearing 15 has determined the location of the thrust direction. 17 is a plain bearing, fitting is carried out to long hole 14a of the shape of a rectangle of a side plate 14, and it slides on the longitudinal direction of this long hole 14a free, and is attached in it possible [displacement]. Pinch roller 5b was supported to revolve enabling free rotation, E mold snap ring 18 was inserted in the edge of pinch roller 5b, and the plain bearing 17 has determined the location of the thrust direction.

[0113] As for long hole 14a formed in the side plate 14, the bending lifting sections 14b and 14c from a side plate 14 are formed in the both sides of the longitudinal configuration. 19 is a compression spring as the 1st energization means, and bending lifting section 14b and a plain bearing 17 did, and it has generated the force energized in the direction where the force which turns pinch roller 5b to conveyance roller 5a, and energizes it, i.e., the sheet pinching force by conveyance roller 5a and pinch roller 5b, becomes strong.

[0114] Moreover, 20 is a flat spring as the 2nd energization means, and has generated the force energized in the direction which bending lifting section 14c and a plain bearing 17 do, and keeps away pinch roller 5b from conveyance roller 5a, i.e., the direction where the sheet pinching force by conveyance roller 5a and pinch roller 5b becomes weak.

[0115] Drawing 2 is an important section strabism explanatory view showing the configuration of the flat spring 20 which is the 2nd energization means. The quality of the material is carrying out the configuration of the character of "\*\*\*" with the stainless steel plate for springs, and the flat spring 20 in this operation gestalt is inserted in the projections 17a and 17b of the shape of a rib prepared in the periphery of a plain bearing 17. Ridgeline 20a of the summit section of the configuration of the character of "\*\*\*" of this flat spring 20 contacts bending lifting section 14c (refer to drawing 1) of a side plate 14. After the front faces of conveyance roller 5a and pinch roller 5b have contacted, the flat spring 20 has generated the force energized in the direction which carries out minute amount deformation and keeps away pinch roller 5b from conveyance roller 5a.

[0116] Here, an example is given and explained about the concrete design value of the compression spring 19 as the 1st energization means, and the flat spring 20 as the 2nd energization means.

[0117] The specification of a compression spring 19 [0118] gestalt: -- a compression spring, wire-size:0.7mm, bore:4.9mm, and number-of-active-coils:15.0 -- natural -- long :21.875mm and [0119] Quality of the material: The stainless steel line for springs (SUS304-WPB), modulus-of-transverse-elasticity:6.8642x1010 Pa (7000kgf/mm<sup>2</sup>) [0120] Load rate : 0.78456Ns (80.0 gf/mm) [0121]/mm In the condition that conveyance roller 5a and pinch roller 5b have touched, the compression spring 19 is set up so that it may become die length of 20mm, and it generates the 1.47105 Ns (150gf) energization force. Since a total of two per every piece are included in the both ends of pinch roller 5b, the compression spring 19 has generated the 2.9421 Ns (300gf) energization force in total in the condition that conveyance roller 5a and pinch roller 5b have touched.

[0122] The specification of a flat spring 20 [0123] gestalt: -- supporting beam type flat-spring, board thickness:0.1mm, width-of-face:2.0mm, beam die-length:5.54mm, and natural actuation length: -- 1.0mm [0124] Quality of the material: The stainless steel plate for springs (SUS304-CSP-H), modulus-of-direct-elasticity:1.66702x1011 Pa (17000kgf/mm<sup>2</sup>) [0125] Load rate : 3.9228Ns (400 gf/mm) [0126]/mm In the condition that conveyance roller 5a and pinch roller 5b have touched, the flat spring 20 is set up so that it may be bent from natural actuation length 0.3mm, and it generates the 1.17684 Ns (120gf) energization force. Since a total of two per every piece are included in the both ends of pinch roller 5b, the flat spring 20 has generated the 2.35368 Ns (240gf) energization force in total in the condition that conveyance roller 5a and pinch roller 5b have touched.

[0127] Here, although the 1st energization means was made into compression spring, you may constitute so that it is not necessary to adhere to compression spring and the energization force may occur with a hauling spring. Although the quality of the material of a spring was made into the stainless steel line for springs (SUS304-WPB), it may use piano wire (SWPB). Moreover, although the 2nd energization means was used as flat spring and considered as the configuration of the character of "++", it is not necessary to adhere to the configuration of the character of "++", and an arch configuration is sufficient. Not flat spring but the so-called Sara spring is sufficient as a gestalt. Although the quality of the material was used as the stainless steel plate for springs (SUS304-CSP-H), it may use the phosphor bronze plate (PBS-H) for springs. It is also possible to make it the configuration which just constitutes so that the comparatively big force may be generated in infinitesimal deformation in short, crushes the piece of rubber with elasticity, and generates the energization force.

[0128] (Energization force in the 2nd conveyance means) Next, the configuration for energizing pinch roller 6b to conveyance roller 6a in the 2nd conveyance means 6 is explained. As mentioned above, the configuration energized in the 1st conveyance means 5 and the 2nd conveyance means 6 is made the same, and since only the magnitude of the energization force is changed, an example is given and explained also here about the concrete design value of the compression spring 21 as the 1st energization means, and the flat spring 22 as the 2nd energization means.

[0129] The specification of a compression spring 21 [0130] gestalt: -- a compression spring, wire-size:0.7mm, bore:4.9mm, and number-of-active-coils:15.0 -- natural -- long :21.25mm and [0131] Quality of the material: The stainless steel line for springs (SUS304-WPB), modulus-of-transverse-elasticity:6.8642x1010 Pa (7000kgf/mm<sup>2</sup>) [0132] Load rate : 0.78456Ns (80.0 gf/mm) [0133]/mm In the condition that conveyance roller 6a and pinch roller 6b have touched, the compression spring 21 is set up so that it may become die length of 20mm, and it generates the 0.9807 Ns (100gf) energization force. Since a total of two per every piece are included in the both ends of pinch roller 6b, the compression spring 21 has generated the 1.9614 Ns (200gf) energization force in total in the condition that conveyance roller 6a and pinch roller 6b have touched.

[0134] The specification of a flat spring 22 [0135] gestalt: -- supporting beam type flat-spring, board thickness:0.1mm, width-of-face:1.25mm, beam die-length:5.54mm, and natural actuation dimension: -- 1.0mm [0136] Quality of the material: The stainless steel plate for springs (SUS304-CSP-H), modulus-of-direct-elasticity:1.66702x1011 Pa (17000kgf/mm<sup>2</sup>) [0137] Load rate : 2.45175Ns (250 gf/mm) [0138]/mm In the condition that conveyance roller 6a and pinch roller 6b have touched, the flat spring 22 is set up so that it may be bent from natural actuation length 0.3mm, and it generates the 0.735525 Ns (75gf) energization force. Since a total of two per every piece are included in the both ends of pinch roller 6b, the flat spring 22 has generated the 1.47105 Ns (150gf) energization force in total in the condition that conveyance roller 6a and pinch roller 6b have touched.

[0139] Here, the configuration, the configuration, the quality of the material, etc. of the 1st energization means and the 2nd energization means do not adhere to the above-mentioned example, and it can say it that it is the same with having described the 1st conveyance means.

[0140] Drawing 3 is the energization force P1 by spacing delta 1 and the 1st energization means of conveyance roller 5a and pinch roller 5b in the 1st conveyance means 5. (1) and energization force P1 by the 2nd energization means (2) and comprehensive energization force P1 It is a graph showing relation. The axis of abscissa of drawing 3 is the spacing delta 1 of conveyance roller 5a and pinch roller 5b. (mm) is expressed. An axis of ordinate expresses the energization force (N), and the force which energizes pinch roller 5b for the force which energizes pinch roller 5b in the direction of conveyance roller 5a in the direction opposite to conveyance roller 5a to a plus (+) side is in it for a minus (-) side.

[0141] As shown in the graph legends of drawing 3, graph \*\* (round-head point line) is the energization force P1. About (1), graph \*\* (triangular point line) is the energization force P1. About (2), graph \*\* (square point line) is the comprehensive energization force P1. It expresses, respectively. So that clearly also from a graph It is the comprehensive energization force P1 the bottom wholly as one energization means about the 1st energization means and the 2nd energization means. In the place of delta= 0mm, it is P1. (1) =2.9421N (300gf) and P1 As resultant force of (2) =-2.35368N (240gf) The value of P1 =0.58842N (60gf) is taken, and it is P1 in the place of delta= 0.3mm. Since it is set

to (2) =0N (0gf), it is P1. It is set to  $P1 = 3.41284N$  (348gf) equally to (1). That is, in the range of  $\delta = 0-0.3mm$ , it is P1. (1) It is P1 from the energization force depended independently. A value only with the small part of (2) is taken. That is, the direction of a load rate when larger than said predetermined value is smaller than the time as the whole energization means including the 1st energization means and the 2nd energization means when spacing of drive body of revolution and follower body of revolution is smaller than a predetermined value.

[0142] Drawing 4 is the energization force P2 by spacing delta 2 and the 1st energization means of conveyance roller 6a and pinch roller 6b in the 2nd conveyance means 6. (1) and energization force P2 by the 2nd energization means (2) and comprehensive energization force P2 It is a graph showing relation. The configuration of a graph is the same as drawing 3.

[0143] As shown in the graph legends of drawing 4 , graph \*\* (round-head point line) is the energization force P2. About (1), graph \*\* (triangular point line) is the energization force P2. About (2), graph \*\* (square point line) is the comprehensive energization force P2. It expresses. It is the comprehensive energization force P2 so that clearly also from a graph. In the place of  $\delta = 0\text{mm}$ , it is  $P_2 = 1.9614\text{N}$  (200gf) and  $P_2$  The value of  $P_2 = 0.49035\text{N}$  (50gf) is taken as resultant force of  $(2) = -1.47105\text{N}$  (150gf). In the place of  $\delta = 0.3\text{mm}$ , it is  $P_2$ . Since it is set to  $(2) = 0\text{N}$  (0gf), it is  $P_2$ . It is set to  $P_2 = 2.43214\text{N}$  (248gf) equally to (1). That is, in the range of  $\delta = 0\text{--}0.3\text{mm}$ , it is  $P_2$ . (1) It is  $P_2$  from the energization force depended independently. A value only with the small part of (2) is taken.

[0144] {behavior of the sheet conveyed} -- in the above configurations with the case where the point of Sheet S rushes into the nip section of conveyance roller 6a as the 2nd conveyance means 6, and pinch roller 6b About the case where the back end section of Sheet S secedes from the nip section of conveyance roller 5a as the 1st conveyance means 5, and pinch roller 5b, the behavior of Sheet S is explained based on the size relation of the force which Sheet S receives from various rollers.

[0145] (When a sheet rushes into the nip section of a roller pair) First, although it is about the case where the point of Sheet S rushes into the nip section of conveyance roller 6a as the 2nd conveyance means 6, and pinch roller 6b, as the column of the technical problem which this case mentioned above tends to solve indicated, by investigating whether the inequality of a formula (13) is realized can explain the behavior of Sheet S.

[0146] It is [0147] when a formula (13) is re-\*\*<sup>(ed)</sup>.

mua1 xP1+(T1 / rb1) < mua2 xP2+(T2 / rb2) xcosthetab2+P2 xtanthetaa2+P2 xtanthetaab2 .... (13) [0148] Here, it verifies whether the following concrete values are applied and a formula (13) is materialized.

[0149]  $\mu_{a1} = \mu_{a2} = 0.65$ ,  $2 = 2.156\text{mm}$  of  $ra1 = ra(s)$ ,  $2 = 1.5\text{mm}$  of  $rb1 = rb(s)$ ,  $t = 0.3\text{mm}$  [0150] First, the value of the left part of a formula (13) is calculated.

[0151] Since it can be considered that the part which the sliding surface of a plain bearing 17 and the sliding surface of pinch roller 5b contact mutually is a contact (it is the tangent of the cylinder sides of a plain bearing 17 and pinch roller 5b in practice) shown by 17c of drawing 1 (b), the load torque  $T_1$  of pinch roller 5b can apply the radius of the plain bearing section to the magnitude of the force which multiplies  $P_1$  by coefficient of friction and is acquired, and it can be asked for it.  $P_1$  Spacing  $\delta_1$  of conveyance roller 5a of the 1st conveyance means 5, and pinch roller 5b Since it is set to 0.3mm (sheet thickness), it is 3.41284Ns (348gf) from the graph of drawing 3. And  $T_1 = P_1 \cdot R$  Depending on magnitude, supposing the radius of the plain bearing section is 1mm and coefficient of friction is 0.2, the value of the left part of a formula (13) is as follows.

[0152]

mu1 xP1+(T1 / rb1) =2.67339N (272.6gf) .... (26) [0153] Next, the value of the right-hand side of a formula (13) is calculated.

[0154] P2 Like the graph of drawing 4, it is the roller spacing delta 2. It changes. Here, it is the roller spacing delta 2 so that intelligibly for explaining the behavior of Sheet S. Not but, angle of rotation  $\theta_{aa2}$  of the roller shown in drawing 14 It describes as a variable. Moreover, include angle  $\theta_{tab2}$  Even if it attaches, it is the relation of the following formula (27) to the include angle  $\theta_{aa2}$ . It can describe as a variable.

[0155]

ra2 xsinthetaa2 =rb2 xsintheta2 .... (27) [0156] T2 P2 Depending on magnitude, the radius of the plain bearing section calculates like the case of Tsaid 1 noting that 1mm coefficient of friction is 0.2.

[0157] Drawing 5 is an include angle thetaa2. It is a graph showing the relation of the magnitude of each term of a formula (13). An axis of abscissa expresses an include angle thetaa2 (deg), and an axis of ordinate expresses the force (N).

[0158] As shown in the graph legends of drawing 5, graph \*\* the value of  $mua1 \times P1 + (T1 / rb1)$  of the left part of a formula (13) graph \*\* --  $mua2 \times P2$  of the right-hand side of a formula (13) graph \*\* --  $x(T2 / rb2) \cos\theta_{tab2}$  of the right-hand side of a formula (13) Graph \*\* is  $P2 \times \tan\theta_{aa2}$  of the right-hand side of a formula (13). Graph \*\* is  $P2$

$xtanthetab2$  of the right-hand side of a formula (13). Graph \*\* expresses the comprehensive inhibition force as the whole right-hand side of a formula (13), respectively.

[0159] Here, if the size relation between graph \*\* and graph \*\* is compared, it is graph \*\* > graph \*\* in all fields. For this reason, if it is in the sheet transport device in this operation gestalt, the inequality of a formula (13) is not realized. Namely, after Sheet S begins inrush in the nip section of conveyance roller 6a and pinch roller 6b in the 2nd conveyance means 6 until it is pinched completely Since the force (graph \*\*) in which the 1st conveyance means 5 tends to hold Sheet S is larger than the magnitude of the force (graph \*\*) which is going to prevent inrush, Sheet S does not slip in the part of the 1st conveyance means 5, and, therefore, it turns out that a sheet conveyance error is not produced.

[0160] Namely, by constituting so that the load rate of an energization means may become small, if spacing of the drive body of revolution of the 2nd conveyance means and follower body of revolution becomes larger than a predetermined value The tip of the thick sheet which has the given thickness more than said predetermined spacing (the 1st thickness) In case it advances into the nip of the drive body of revolution of the 2nd conveyance means, and follower body of revolution, the conveyance direction component (the conveyance direction is hard flow) of the reaction force to which a sheet tip originates in the energization force of the energization means received from drive body of revolution and follower body of revolution is constituted so that it may not become larger than the conveyance force by the 1st conveyance means.

[0161] An energization means is smaller than a load rate (the 2nd load rate) when the direction of the constant (the 1st load rate) of the spring when pinching the thick sheet of the 1st thickness pinches the sheet of the 2nd thin thickness.

[0162] (When a sheet secedes from the nip section of a roller pair) Next, although it is about the case where the back end section of Sheet S secedes from the nip section of conveyance roller 5a (the 1st drive body of revolution) as the 1st conveyance means 5, and pinch roller 5b (the 1st follower body of revolution) As the column of the technical problem which this case mentioned above also in this case tends to solve indicated, by investigating whether the inequality of a formula (22) is realized can explain the behavior of Sheet S.

[0163] It is [0164] when a formula (22) is re-\*\* (ed).

P1  $xtanthetaa1 + P1 xtanthetab1 > R$  .... (22) [0165] Here, it verifies whether the following concrete values are applied and a formula (22) is materialized.

[0166]  $mua1 = mua2 = 0.65$ ,  $2 = 2.156\text{mm}$  of  $ra1 = ra(s)$ ,  $2 = 1.5\text{mm}$  of  $rb1 = rb(s)$ ,  $t = 0.3\text{mm}$  [0167] First, the value of the left part of a formula (22) is calculated.

[0168] P1 It is the roller spacing delta 1 like the graph of drawing 3. It changes. Here, it is the roller spacing delta 1 so that intelligibly for explaining the behavior of Sheet S. Not but, roller include angle thetaa1 shown in drawing 15 It describes as a variable. Moreover, include angle thetab1 Even if it attaches, it is the relation of the following formula (28) to the include angle thetaa1. It can describe as a variable.

[0169]

$ra1 \times \sin \theta a1 = rb1 \times \sin \theta b1$  .... (28) [0170] R of the right-hand side of a formula (22) is the force R4 which converted into the force on each front face of a roller the load torque T5 expressed with conveyance roller 6a, sliding-friction torque T four in each bearing of pinch roller 6b, T2, and a formula (25), respectively, and the force synthesizing R2 and R5.

[0171] P2 at this time Spacing delta 2 of conveyance roller 6a (the 2nd drive body of revolution) of the 2nd conveyance means 6, and pinch roller 6b (the 2nd follower body of revolution) Since it is set to 0.3mm (sheet thickness), As mentioned above, it is 2.43214Ns (248gf) (refer to the graph of drawing 4). As for the value of R synthesizing R4, and R2 and R5, the radius of 1.5mm coefficient of friction of the plain bearing section of conveyance roller 6a is as follows supposing the radius of the plain bearing section of 0.2 and pinch roller 6b is [ 1mm coefficient of friction ] 0.2.

[0172]  $R4 = T4 / (\text{radius of conveyance roller } 6a) = 248\text{gf} \times 0.2 \times 1.5\text{mm} / 2.156\text{mm}$  [0173]  $R2 = T2 / (\text{radius of pinch roller } 6b) = 248\text{gf} \times 0.2 \times 1\text{mm} / 1.5\text{mm}$  [0174]  $R5 = T5 / (\text{radius of conveyance roller } 6a) = 150\text{gf} \times 1\text{mm} / 2.156\text{mm}$  [0175]

$R = R4 + R2 + R5 = 1.34454\text{N}$  (137.1gf) .... (29) [0176] Drawing 6 is the include angle thetaa1 of conveyance roller 6a. It is a graph showing the relation of the magnitude of each term of a formula (22).

[0177] An axis of abscissa expresses the roller include angle thetaa1 (deg), and an axis of ordinate expresses the force (N).

[0178] As shown in the graph legends of drawing 6, for graph \*\*, graph \*\* is  $P1 xtanthetab1$  of a formula (22) about the value of  $P1 xtanthetaa1$  of the left part of a formula (22). Graph \*\* expresses a value and the comprehensive foot press force of the whole left part of a formula (22) and graph \*\* express R of the right-hand side of a formula (22), respectively.

[0179] Here, if the size relation between graph \*\* and graph \*\* is compared, since it is \*\* < \*\* in all fields, the inequality of a formula (22) will not be realized. Namely, after Sheet S begins balking from the nip section of

conveyance roller 5a in the 1st conveyance means 5, and pinch roller 5b until it breaks away completely Since the force (graph \*\*) in which the 2nd conveyance means 6 tends to hold Sheet S is larger than the magnitude of the force (graph \*\*) which is going to kick at Sheet S, It is not kicked even if Sheet S has play, such as backlash, in the drive transfer system of the 2nd conveyance means 6, and it turns out that a conveyance error is not produced.

[0180] Namely, by constituting so that the load rate of an energization means may become small, if spacing of the 1st drive body of revolution of the 1st conveyance means and the 1st follower body of revolution becomes larger than a predetermined value The back end of the thick sheet which has the given thickness more than said predetermined spacing (the 1st thickness) In case it escapes from the nip of the 1st drive body of revolution of the 1st conveyance means, and the 1st follower body of revolution The force in which the sheet back end originates in the energization force of the energization means received from the 1st drive body of revolution and the 1st follower body of revolution It is constituted so that it may become smaller than the force which prevents advance of the sheet resulting from the resistance torque in the bearing of the 2nd drive body of revolution which a sheet receives from the 2nd conveyance means, and the 2nd follower body of revolution, and the load torque by the regulation means.

[0181] An energization means is smaller than a load rate (the 2nd load rate) when the direction of the constant (the 1st load rate) of the spring when pinching the thick sheet of the 1st thickness pinches the sheet of the 2nd thin thickness.

[0182] As mentioned above, since the sheet thrust by the conveyance roller and the pinch roller established a 1st energization means to energize in the direction which becomes strong, and a 2nd energization means to energize in the direction which becomes weak In the field where roller spacing from which inrush of the point of a sheet and balking of the sheet back end section become a problem is small even when a thick sheet is used, the contact pressure between rollers becomes small. Generating of the conveyance error called an inrush gap of a sheet and a foot press gap is prevented by this, and degradation of record precision is prevented.

[0183] Moreover, it constitutes possible [ displacement of a pinch roller ] to a conveyance roller, and the 1st energization means can energize said press member in said direction of drive body of revolution, and said 2nd energization means can constitute easily an energization means by which the thrust to a sheet becomes strong, and the energization means which becomes weak from constituting so that said press member may be energized in the direction which separates from said drive body of revolution.

[0184] Moreover, by constituting said 1st energization means and the 2nd energization means from a spring member, and setting up the load rate of the 2nd energization means greatly rather than the load rate of the 1st energization means Since 10 minutes of need are made to generate the large pinching force when the thick sheet which needs the conveyance force most is being pinched, and 10 minutes of need are made to generate the small pinching force when the conveyance force is pinching the thin sheet which may be comparatively small There is effectiveness also in power-saving by preventing that Siwa and a tear occur on a thin sheet, and pressing down a drive load small. Moreover, it is possible by constituting said 1st energization means from a compression spring, and constituting the 2nd energization means from a flat spring to attach each energization means easily.

[0185] Moreover, the inrush gap at the time of a sheet rushing into the nip section of the 2nd conveyance means 6 can be certainly suppressed by setting up more greatly than the sheet pinching force by the 2nd conveyance means 6 the sheet pinching force by the 1st conveyance means 5.

[0186] Operation gestalt] besides [ Although the pinch roller was illustrated in addition with the operation gestalt mentioned above as a press member which presses a sheet on the conveyance roller which is drive body of revolution, as long as this invention is the member which does not need to limit to the member rotated not necessarily as a member which presses a sheet, and can press a sheet on a conveyance roller by the predetermined force, it may be a member which carries out rubbing to a sheet.

[0187] Moreover, it is not necessary to also limit the drive body of revolution which gives the conveyance force to a sheet to a roller-like thing for example, and even if it is body of revolution, such as a rotation belt, the same effectiveness as a conveyance roller is acquired.

[0188] Moreover, by establishing the 1st energization means and the 2nd energization means which were mentioned above even when a sheet was conveyed by 1 set of drive body of revolution, and the press member, although the operation gestalt mentioned above showed the example which prepared the sheet transport device which becomes the upstream and the downstream of the record means 2 from a conveyance roller and a pinch roller, respectively, since it becomes possible to suppress inrush of a sheet, and the conveyance error at the time of balking, it is effective.

[0189] Furthermore, although the serial recording method which makes carriage scan as a record means was illustrated with the operation gestalt mentioned above, naturally you may be the record means of a full line method, and although this invention is effective when a record means is in the ink jet recording method which does not contact a sheet and raises conveyance precision, it is also possible for it not to be necessary to necessarily limit this recording method to an

ink jet recording method for example, and to use an electrophotography recording method, a thermal imprint recording method, etc.

[0190] Furthermore, although the printer was illustrated with the operation gestalt mentioned above, naturally as a gestalt of image formation equipment, you may be other image formation equipments, such as a copying machine and facsimile apparatus.

[0191] Moreover, the sheet transport device of this invention conveys not only image formation equipment but a sheet manuscript, and also when the image indicated in this manuscript is applied to the image reader read with an image reading means, since it can convey a sheet manuscript with high degree of accuracy, highly precise reading of it becomes possible.

[0192]

[Effect of the Invention] Since it was constituted as mentioned above, even when this invention carries out pinching conveyance of the sheet by drive body of revolution and the press member and a thick sheet is used as a sheet, it prevents generating of a conveyance error to which inrush of the point of a sheet and the sheet back end section are called an inrush gap and a foot press gap at the time of balking, and highly precise sheet conveyance of it is attained.

[0193] For this reason, when the sheet transport device of this invention is used for image formation equipment, degradation of record precision can be prevented, and when it uses for an image reader, degradation of reading precision can be prevented.

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[Translation done.]

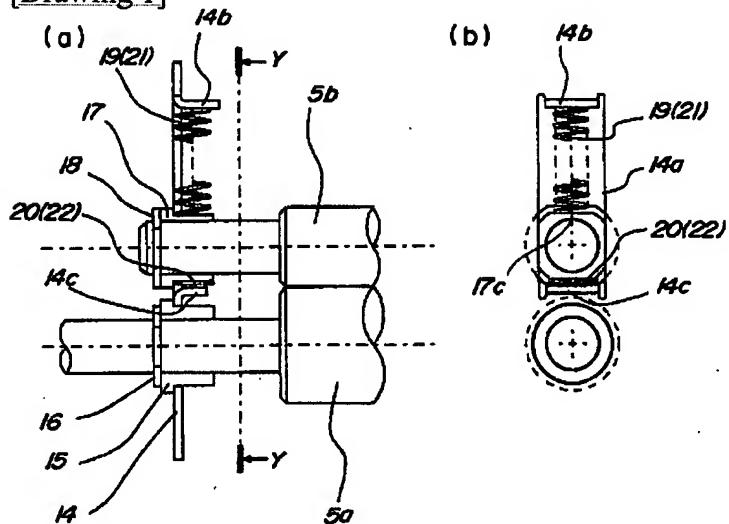
## \* NOTICES \*

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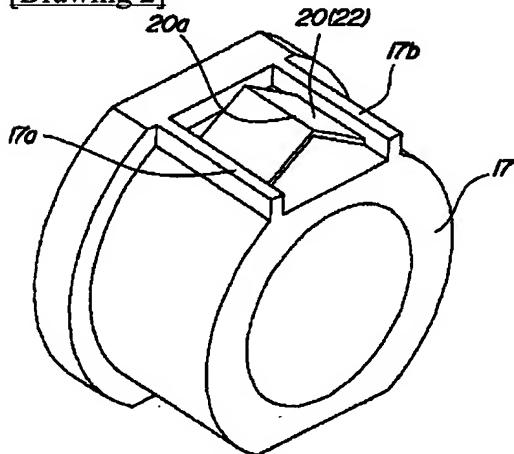
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## DRAWINGS

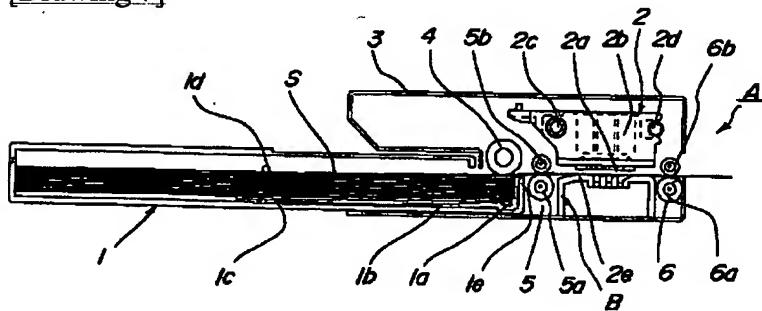
## [Drawing 1]



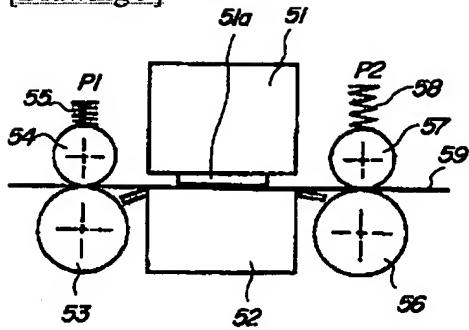
## [Drawing 2]



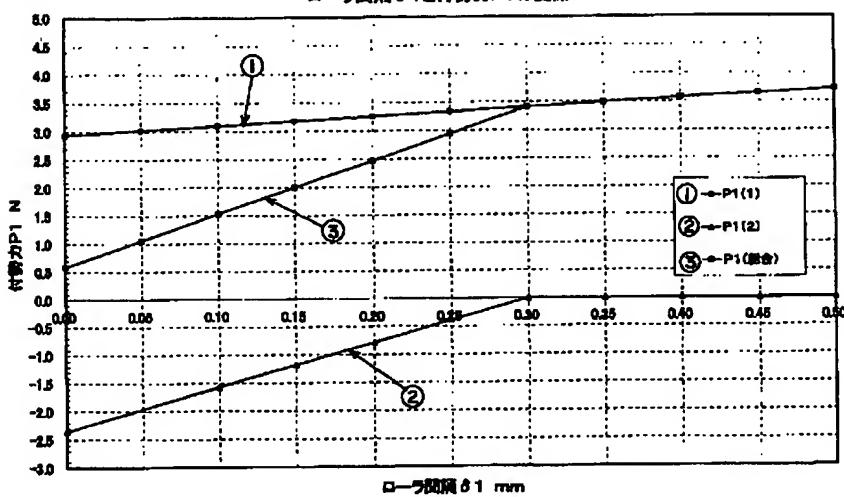
## [Drawing 7]



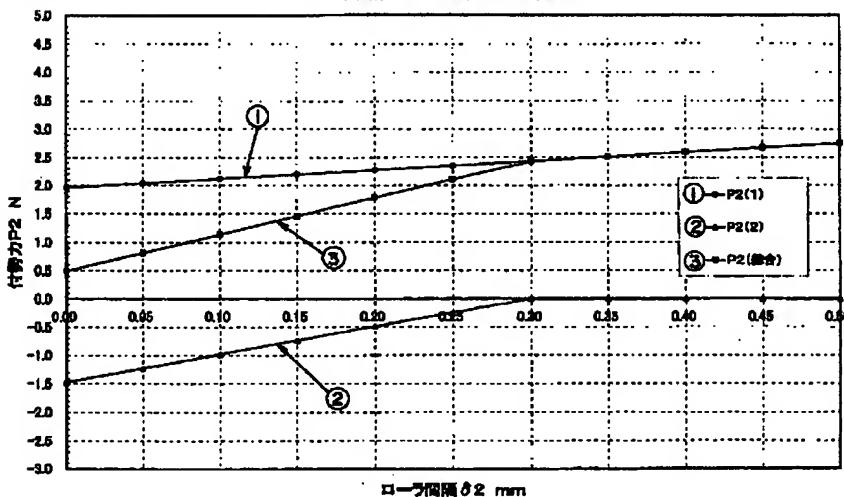
[Drawing 9]



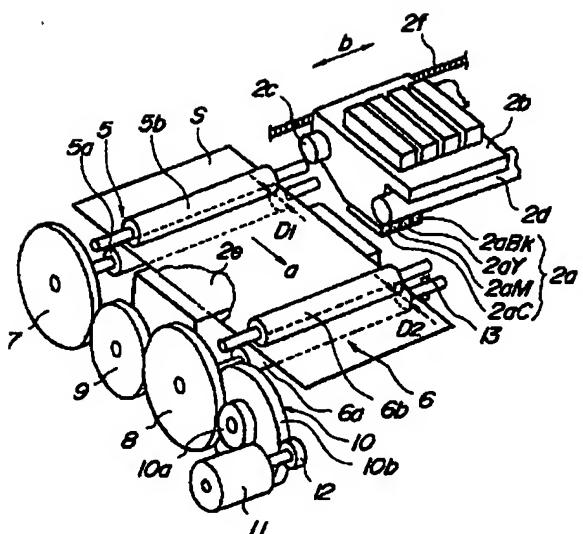
[Drawing 3]

ローラ間隔  $\delta 1$  と付勢力  $P1$  の関係

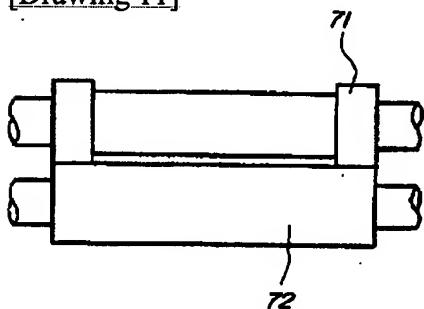
[Drawing 4]

ローラ間隔  $\delta 2$  と付勢力  $P2$  の関係

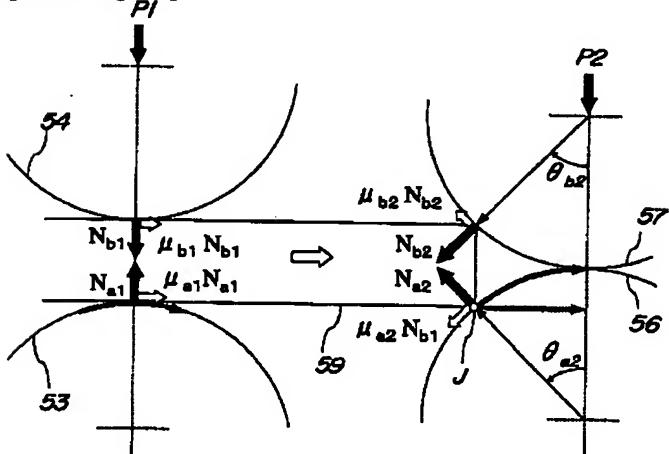
[Drawing 8]



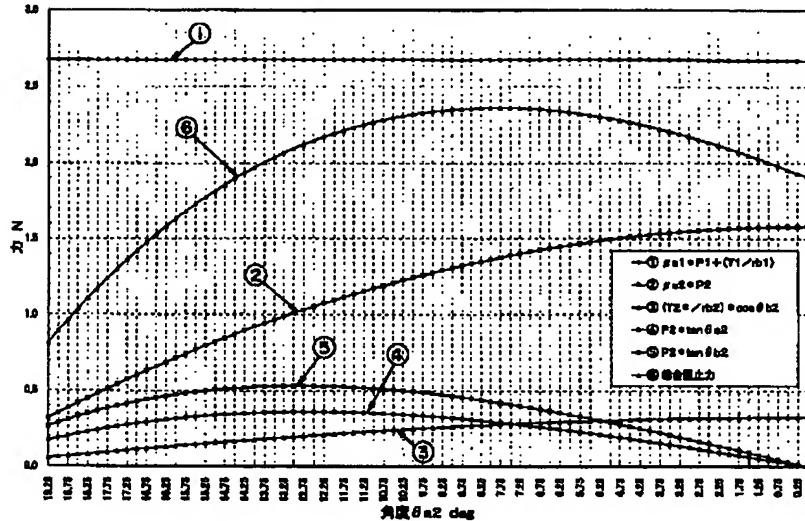
### [Drawing 11]



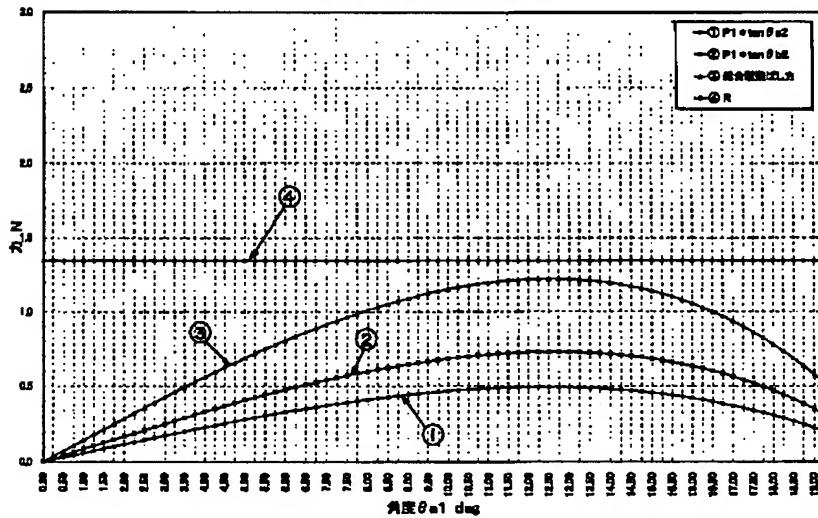
### [Drawing 14]



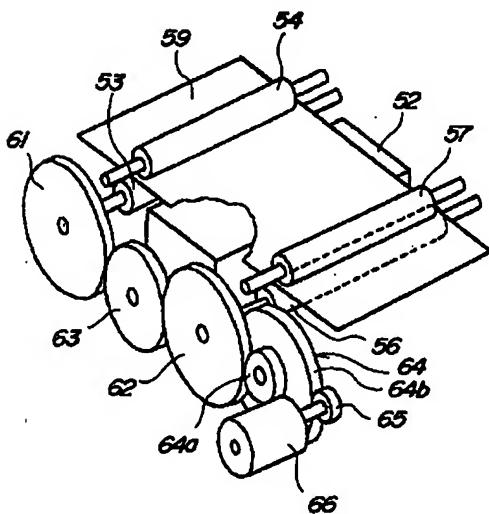
### [Drawing 5]

角度  $\theta_{a2}$  と各力の大きさの関係

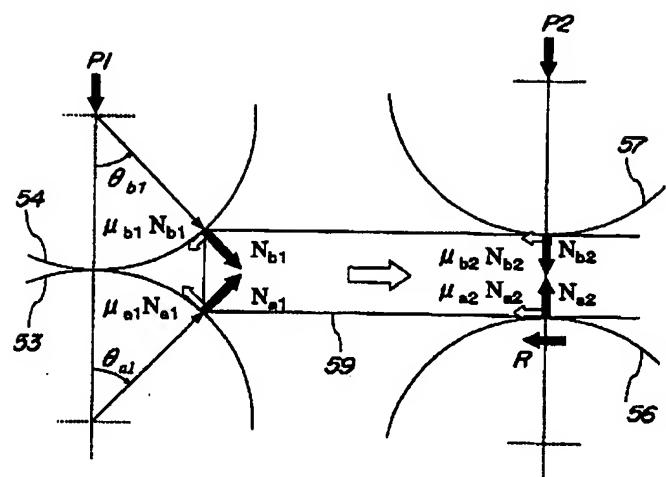
[Drawing 6]

角度  $\theta_{a1}$  と各力の大きさの関係

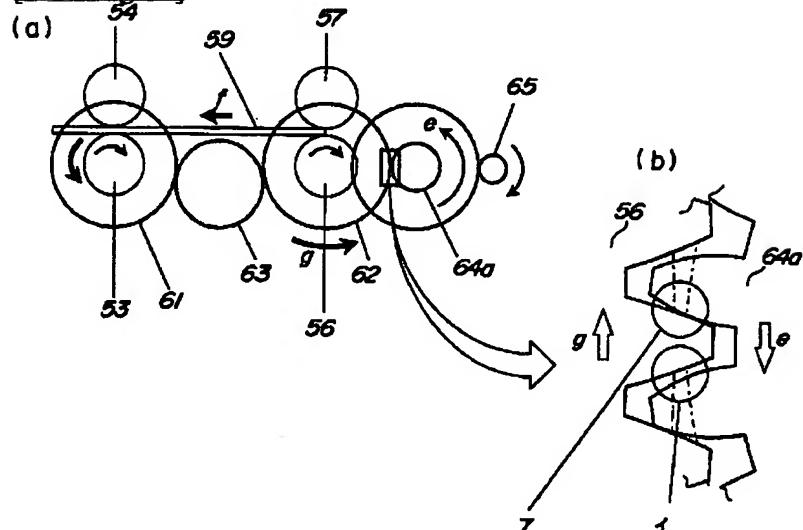
[Drawing 10]



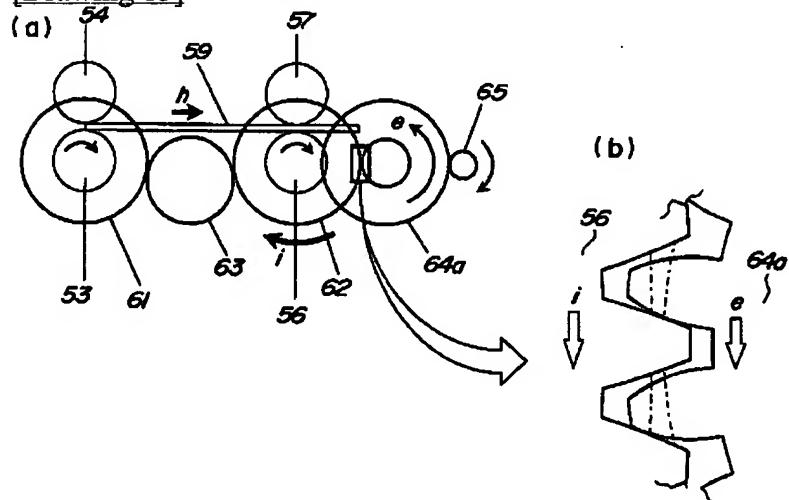
[Drawing 15]



[Drawing 12]



[Drawing 13]



[Translation done.]